MASTER OF MILITARY STUDIES

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INTERWAR-PERIOD GAMING TODAY FOR CONFLICTS TOMORROW:
PRESS 'START' TO PLAY

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Preface

When I joined the Marine Corps Warfighting Laboratory's (MCWL) Wargaming

Division as a defense contractor in 2009, I had little knowledge of the origin, history, processes,

and institutional rationale for this tool of military discovery. Seven years later, this thesis paper

represents my effort to fill that void and make a humble contribution to the wargaming

community. I would like to thank my interview subjects for their time and patience: Dr. Peter

Perla and Dr. Ed McGrady of the Center for Naval Analyses; Dr. William Lademan of MCWL's

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the right questions to help me shape this project. Errors are mine alone.

Executive Summary

Title: Interwar-Period Gaming Today for Conflicts Tomorrow: Press 'Start' to Play

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Thesis: Wargaming is a relatively inexpensive, yet powerful tool that offers creative solutions to complex problems. Current senior US defense leaders should look to wargaming's best practices – particularly German, Japanese, and American games between the First and Second World Wars – to shed light on an uncertain future featuring evolving adversaries, emerging concepts, and untested capabilities.

Discussion: During the period between the First and Second World Wars, wargaming anchored the curricula of professional military education (PME) institutions, allowed commanders and staffs to rehearse and adjust plans for major campaigns, provided a venue for alternate and enemy perspectives, and informed the development of new concepts and capabilities that fed a "cycle of research" to support innovation.

From the moment the Treaty of Versailles ended The Great War and set the conditions for its successor, military leaders sought an edge for another global conflict that many observers considered likely. In Germany, wargaming expanded its role in the Wehrmacht's cultural landscape – officers learned the value of wargames at the famed *Kriegsakademie*, then applied gaming techniques to develop operational options and explore potential adversary actions during planning for campaigns such as the 1940 invasion of France and the Low Countries. German officers also used games to evolve air doctrine and inform manufacturing decisions that would have heavy implications for the *Luftwaffe's* interdiction and strategic-bombing capabilities.

In Japan, Admiral Isoroku Yamamoto employed wargames to study the sequencing of his complex Pacific campaign, examine likely reactions by American and British forces, and allow his subordinate commanders and their staffs to rehearse and adjust plans for major campaigns such as the 1941 attack on the US Pacific Fleet at Pearl Harbor and the strike against the American stronghold on Midway Island.

In the United States, American naval officers played hundreds of wargames at the Naval War College in Newport, Rhode Island. These games allowed generations of future naval leaders to develop a shared mental model about the strategic and operational framework of the approaching conflict against Japan and provided a venue to test new concepts such as carrier aviation.

Conclusion: Interwar-period gaming provided users with a chance to shed light on an opaque future. Although the threats are different, senior US defense leaders face similar ambiguity now. The reassertion of Russia in world affairs, a militarily stronger China, and a multitude of powerful non-state actors have dramatically changed the strategic landscape. Fast-developing capabilities, nascent technologies, unmanned weapons platforms, 3D printing, and human-machine interfacing will likely play a part in the next great conflict. With no cost in blood and minimal in treasure, wargames can empower future US military leaders to exert intellectual leadership and innovate to be better prepared for the future.

As the interwar period suggests, wargaming is one of the most effective means available to offer senior leaders a glimpse of future conflict, however incomplete. Wargames offer opportunities to test new ideas and explore the art of the possible. They help us imagine alternative ways of operating and envision new capabilities that might make a difference on future battlefields.[1]

– Deputy Secretary of Defense Robert O. Work
and General Paul Selva, Vice Chairman of the Joint Chiefs of Staff
December 8, 2015

Introduction: Why Wargame?

Chester Nimitz fought the Japanese long before they attacked Pearl Harbor. During wargames played at the Naval War College in 1922, the promising commander raced a make-believe fleet thousands of miles across the Pacific Ocean to reinforce the besieged American garrison in the Philippines. Nimitz pushed small icons representing US aircraft carriers, battleships, cruisers, destroyers, and auxiliaries across a large map of the Pacific on the floor of the college's game room – getting them west but stretching sea lines of communication across the vast ocean. Classmates mimicking Japanese naval doctrine maneuvered their fleet east – isolating the Philippines, seizing US bases, and meeting the American flotilla's advance. Under the watchful eyes of faculty serving as game umpires, battles ensued. Win or lose, learning occurred without shedding a drop of sailor's blood or firing a single round. After the Japanese Navy attacked the US Pacific Fleet at anchor in Pearl Harbor on December 7, 1941, Nimitz – by then, the commander of the Pacific Fleet – felt ready for the coming conflict. He later wrote, "The war with Japan had been re-enacted in the game rooms at the Naval War College by so many people and in so many different ways that nothing that happened during the war was a surprise" except for the kamikaze.[2] Through wargames in Newport – and others played in Tokyo and Berlin – military professionals learned about themselves, their adversaries, and potential solutions to future challenges. When used correctly, wargaming is a relatively inexpensive, yet

powerful tool that offers creative solutions to complex problems. When used incorrectly, wargaming confirms poor assumptions, shapes misperceptions, and reinforces hubris. At their best, wargames are vehicles for the pursuit of intellectual honesty and leadership. At their worst, they are barely concealed advocacy platforms that set up false choices for game play to reinforce pre-ordained outcomes.[3]

Nevertheless, current senior US defense leaders should look to wargaming's best practices – particularly German, Japanese, and American games between the First and Second World Wars – to shed light on an uncertain future featuring evolving adversaries, emerging concepts, and untested capabilities. During the period between the First and Second World Wars, wargaming anchored the curricula of professional military education (PME) institutions, allowed commanders and staffs to rehearse and adjust plans for major campaigns, provided a venue for alternate and enemy perspectives, and informed the development of new concepts and capabilities that fed a "cycle of research" to support innovation.[4] Today's US joint force would be wise to apply the best traits of gaming from the interwar-period of the early twentieth century, when wargames blended effectively with the military cultures of Germany, Japan, and the United States to yield insights that affected how they fought during the Second World War.

Military cultures that used wargames reaped their benefits. From the moment the Treaty of Versailles ended The Great War and set the conditions for its successor, senior leaders sought an edge for another global conflict that many observers considered likely.[5] In Germany, wargaming expanded its role in the *Wehrmacht's* cultural landscape. Officers learned the value of wargames at the famed *Kriegsakademie*, then applied gaming techniques to develop operational options and explore potential adversary actions during planning for campaigns such as the 1940 invasion of France and the Low Countries. German officers also used wargames to

evolve air doctrine and inform aircraft manufacturing decisions that would have serious implications for the *Luftwaffe's* strategic-bombing capabilities in the European theater. In Japan, Admiral Isoroku Yamamoto employed wargames to study the sequencing of his complex Pacific campaign, examine the likely reactions of American and British forces, and allow his subordinate commanders and their staffs to rehearse and adjust plans for major campaigns such as the 1941 attack on Pearl Harbor and the strike against the American stronghold on Midway Island. In the United States, American naval officers played hundreds of wargames at the Naval War College in Newport, Rhode Island. These games allowed generations of future naval leaders to develop a shared mental model[6] about the strategic and operational framework of the approaching conflict against Japan and provided a venue to test new concepts such as carrier aviation. (See Appendix A for information about wargaming and shared mental models). Between 1919 and 1941, German, Japanese, and American wargaming techniques explored new ways of fighting, informed campaign planning, and gave officers decision-making and planning practice before war erupted.

This paper examines interwar-period gaming in three parts. The first part defines wargaming, discusses its utility, and differentiates it from other military analytic tools. The second part details how the militaries of Germany, Japan, and the United States employed wargames to train and educate their officers, plan and execute major campaigns, and inform the development of new concepts and capabilities for the Second World War. The third part concludes by identifying best wargaming practices that can be applied to today's US defense establishment in order to prepare for future conflicts.

Part I: What is a Wargame?

Wargaming must be defined and characterized in order to facilitate substantive

discussion. Confusion reigns when military professionals, including senior officers and

government civilians, talk about wargaming. Currently, no doctrinal definition for "wargame" or

"wargaming" exists.[7] The 469-page *Department of Defense Dictionary of Military and*

Associated Terms mentions either term three times, but never actually describes what a wargame

is, discusses its traits, or examines its potential utility.[8] Professional wargame designers have

latched onto variations of a definition established by Dr. Peter Perla, a prominent American

wargame designer and longtime research scientist at the Center for Naval Analyses:

> "A warfare model or simulation that does not involve the operation of actual
> forces, in which the flow of events affects and is affected by decisions made
> during the course of those events by players representing the opposing sides."[9]

The military gaming community also acknowledges a similar definition provided by the late

Francis J. McHugh, an influential game designer at the US Naval War College:

> "A simulation of selected aspects of a military operation in accordance with
> predetermined rules, data, and procedures to provide decision-making experience
> or provide decision-making information that is applicable to real-world
> situations."[10]

Wargames are often confused with other problem-solving activities that do not involve

the use of actual forces, including course of action (COA) wargaming, tabletop exercises

(TTXs), tactical exercises without troops (TEWTs), and rehearsal-of-concept (ROC) drills. COA

wargaming is a phase of American and British military planning processes in which options are

systematically examined and refined based on enemy capabilities and limitations, potential

actions and reactions, and characteristics of the operational environment. During COA

wargames, a planning team refines existing options with the help of a so-called "red cell"[11] that

role-plays and represents the activities of potential adversaries and other factors that could

threaten a mission.[12] TTXs are scenario-based discussions involving senior officers and staff used to familiarize participants with plans, policies, procedures, and contingencies. TEWTs are commander-led exercises that use current doctrine to exercise subordinate leaders and staff responses against a given threat or scenario on the terrain in which they would fight. ROC drills are detailed rehearsals involving all commanders and staff for a given operation. Although TTXs, TEWTs, and ROC drills are scenario-driven exercises that test decision-making, they lack the "contest of wills," which is an essential ingredient of wargaming.

Like many tools, wargames hold both great promise and pitfalls. Wargaming is a subjective, people-driven tool that is effective at investigating processes, organizing ideas, exploring issues, explaining implications, and identifying questions for future study.[13] In the interwar years, these potential benefits drove military leaders to use wargames to study, question, and understand the plans they had crafted prior to the outbreak of the Second World War. At the same time, wargaming is not an effective tool for calculating outcomes, proving theories, predicting "winners," producing numbers, and generating conclusions.[14]

Game designers continually sidestep wargaming's pitfalls to fulfill their promise. Wargames prove their military utility every time a commander embarks on a mental exercise to rehearse possible solutions to a problem, project an adversary's response, and assess the decisions made by friend and foe. "It enables a commander and his staff to review assumptions, detect inadequate or untimely support, verify time and space factors, and reconcile divergent opinions," writes Dr. Williamson Murray. "The game provides a means of testing ideas, of coordinating services and branches, and of exploring and considering all possible contingencies prior to the drafting of the final operational plan."[15] Realistic wargames generate useful insights for subsequent study and live-force exercising when they involve commanders who are experts

in the topics being examined, and feature accurate depictions of adversaries and the operational environment.

However, interwar-period gaming experiences also exposed potential problems. German wargames overwhelmingly focused on the operational and tactical implications of its European offensives, but neglected to scrutinize the aggressive strategic guidance that drove its campaigns – and significant operational losses – in Poland and Norway. Japanese wargaming featured a deterministic nature, confirming assumptions senior leaders made before they commissioned the games. American wargames at the Naval War College correctly invested intellectual bandwidth on war in the Pacific and the likely threat – Japan – but overlooked the pivotal 2,073-day Battle of the Atlantic, where German U-boats sank 3,500 Allied merchant ships with 13.5 million tons of shipping bound for the European theater. The Allies lost 175 warships and tens of thousands of merchant and military seamen in the Atlantic.[16]

Part II: Interwar-Period Case Studies – Germany, Japan, and the United States

By the beginning of the interwar years, wargaming had gained acceptance among military leaders in Germany, Japan, and the United States. For the German military, Helmuth von Moltke used wargames to train and educate officers at the *Kriegsakademie* during his tenure as chief of the Prussian and German General Staff from 1857-88.[17] Generations of German Army officers accepted gaming as an essential part of training, educating, and developing leaders, and they continued the practice through the early years of the Second World War. In the late 19th century, German officers passed wargaming to their Japanese counterparts, who expanded the use of gaming for campaign planning and decision-making processes. Wargaming eventually became part of the regular curriculum at the Japanese Naval Staff College, and Japanese naval leaders attributed their success during the 1904-05 Russo-Japanese War to

insights generated by these games.[18] Students and faculty used wargames to test new ideas about

tactical maneuvers, night attacks, fleet formations, principles of engagement, and supporting

forces.[19] Unlike the Germans, Japanese interwar-period games gained a deterministic quality,

with officers using game insights as evidence to support courses of action that leaders had

already favored. In the United States, a Navy lieutenant named William McCarty Little

introduced gaming to the Naval War College in Newport during a series of lectures in 1887. The

faculty experimented with the new technique in the ensuing years and incorporated it as a regular

educational tool in 1893.[20] During his interwar-period tenure as the president of the Naval War

College, Admiral William Sims emphasized the need to test students' decision-making abilities

through the use of wargames: officers with otherwise strong reputations exposed their "lack of

knowledge … of the proper tactics and strategy" in the war college game rooms in Newport.[21]

Lessons from Germany: *Kriegsakademie*, Von Seeckt, and the Shared Mental Model

Wargaming realized its potential as a tool for learning in interwar Germany for several

reasons. The PME system embraced gaming as a training and educational tool that encouraged

introspection about decision-making and fostered subordinate initiative and adaptability. Senior

benefactors valued wargames and the insights they generated. Wargames also contributed to a

shared mental model about the strategic and operational dilemmas that the country faced upon

the outbreak of war. The cultural indoctrination of wargaming expanded in German PME

institutions, where officers played games to reinforce learning from lectures and seminars.

Senior officers led students on staff rides that integrated elements of wargaming, forcing students

to confront operational problems and formulate solutions. They conducted these staff rides and

wargames in the regions of Central Europe that would become battlefields by 1939-40, including

the areas adjacent to France and the Low Countries in the Second World War's western theater

and regions facing Poland and Czechoslovakia in the east. In order to graduate, every officer

who attended the *Kriegsakademie* learned how to plan a wargame, execute the event, and apply

insights toward future planning.[22] After graduating and arriving at their parent units, officers

found wargames to be an integral part of their continued maturation as military professionals.

Every *Wehrmacht* unit from battalion or squadron upward conducted games as an intellectual

substitute for live-force exercises, which had diminished in frequency due to funding shortages

and troop-number restrictions imposed by the Treaty of Versailles at the end of the First World

War.[23]

Senior benefactors in the German Army reinforced the importance of gaming. The post-

war restrictions forced the newly appointed chief of the *Reichswehr*, Hans von Seeckt, to find

different ways of ensuring the army adapted after The Great War so hard-won lessons could help

inform how they would fight the next great conflict – an inevitability in the eyes of many

German officers.[24] In addition to ordering a sweeping review of the German military's

performance during the First World War, the German military chief turned to wargaming to

prepare the next generation of officers.

Von Seeckt, an adherent of maneuver warfare, believed that German officers needed to

understand the theoretical aspects of warfare to be prepared for a dynamic future battlefield.

Wargaming became an essential element of that understanding.[25] He expanded the term

"wargame" to include other activities that resemble the modern-day TEWT and TTX, planning

exercises (akin to the theater campaign planning central to the capstone "Nine Innings" exercise

at US Marine Corps Command and Staff College), command-post exercises, and terrain

discussions.[26] By the end of von Seeckt's tenure as chief of the general staff in 1926,

Reichswehr officers examined Germany's perpetual strategic dilemma – ensconced in Central

Europe surrounded by potential adversaries – through wargames, with leaders at all levels immersing themselves in the details of existing plans, likely enemy reactions to German offensives, and the challenges of the physical terrain across Europe.

Other senior leaders who played wargames in this officer development system eventually used games to plan the opening stages of the Second World War. General Franz Halder, chief of the Army General Staff, commissioned dozens of wargames to examine different options for invading France and the Low Countries in 1940.[27] General Ludwig Beck, chief of the German General Staff from 1935 through 1938, also employed games in his 1936 effort to prepare a new manual of modern operations for the entire army. After he and his advisers had decided on the principles they judged as most important in the new conditions of warfare of their time, they called on "seasoned officers" to test those principles using wargames.[28] In the air, military aviation pioneer Helmuth Wilberg shaped future *Luftwaffe* operational employment through wargames during his rigorous critique of German air doctrine following the First World War.[29] On the sea, German submarine force chief Karl Doenitz, a future grand admiral, utilized games to explore the employment of U-boats. Doenitz's games generated new ideas such as wolfpack tactics and suggested that a three-hundred submarine fleet would be necessary to neutralize Allied merchant shipping in the Atlantic.[30]

These wargames exposed strategic and operational dilemmas that fed a shared mental model for *Wehrmacht* leaders and their subordinate commanders. In this context, mental models comprise the collective tools, products, processes, and experiences that players use to make sense of the world. Games conducted prior to the invasion of France examined various iterations of Plan Yellow, the campaign to invade France and the Low Countries, and contributed to the German military's shared mental model for how they would fight the next war. Among the

numerous versions of Plan Yellow, the German Army General Staff settled on a daring version (some called it "reckless") that feigned an attack on Belgium and the Netherlands. The feint would distract Allied Forces from the campaign's main effort – an offensive through the Ardennes Forest that pushed German tank divisions across the Meuse River toward the English Channel, cutting off Allied lines of communication back to France.[31] The wargames featured the services of Lieutenant Colonel Ulrich Liss, an expert on Western military doctrine who role-played as the commander of Allied Forces, French General Maurice Gamelin.[32] Liss' red cell accurately portrayed the likely Allied reaction – a slow response to a German main effort thrust through the Ardennes. "Liss had come to a view similar to that articulated by Hitler, namely that 'to operate and to act quickly … does not come easily either to the systematic French or to the ponderous English,'" wrote Ernest May.[33] Liss' assessment during the games prompted Halder to eventually assign *Schwerpunkt,* or focus of effort, to Army Group A, which would push through the Ardennes. Colonel-General Gerd Von Rundstedt, commander of Group A, lamented that "the campaign could never be won."[34] However, the Germans did win, thanks partly to an insight generated by an accurate representation of the enemy as part of wargaming for the campaign. The Allied Forces failed to act quickly enough on the German deception until Group A's divisions had crossed the Meuse on their way toward the English Channel.

In the spirit of *Auftragstaktik,*[35] gaming helped establish the environment that fostered initiative among *Wehrmacht* subordinate commanders. Officers constantly examined and questioned the assumptions behind their own decisions in wargames, which fostered an environment that encouraged initiative and field innovation. Some subordinate leaders became less afraid to deviate from their original tasks and adjust to evolving situations during combat in order to meet their commander's intent. During the offensive against France and the Low

Countries in May 1940, after General Heinz Guderian's Panzer Corps crossed the Meuse River at Sedan, he chose to press the attack west with all available forces and drive toward the English Channel, rather than make the doctrinally sound decision of slowing down and strengthening his corps' bridgehead to the south.[36] In another instance during the campaign, General Erwin Rommel's Seventh Panzer Division neared the far end of the "extended Maginot Line" at the French-Belgian border – far ahead of his adjacent units – and lost radio communications with his corps headquarters. Rommel's superiors never issued guidance for this stage of the operation because they did not predict their advance would proceed as quickly and successfully as it did.[37] Like Guderian, Rommel pressed ahead with the assault and pushed his panzers west until he ran short of ammunition and fuel at Le Cateau.[38] "German generals, even German colonels and majors, certainly felt freer to try new approaches and tactics than did their counterparts in the French army or (British forces)," wrote May.[39]

In the *Wehrmacht*, commanders used wargames to assess their subordinates' strengths and weaknesses under stress. They also used games to foster trust and understanding between senior and junior officers through teaching moments in the context of the game scenario. These games became "the best way for commanders to make known to subordinates their views on various aspects of warfare," writes Dr. Milan Vego, a professor at the US Naval War College. "Wargames were an important means for the 'spiritual' preparation for war and for shaping unified tactical and strategic views."[40] Through gaming, leaders established a climate that allowed for mistakes to be studied and encouraged subordinate commanders to adapt their plans to changing realities in battle. The Germans also utilized wargaming to examine evolving principles within the institution about combined arms, armor and maneuver, and air doctrine in order to inform capabilities development and national resourcing decisions that influenced, for

example, the manufacture of close-air support platforms over long-range strategic bombers.[41] (By the mid- to late 1930s, Germany diverted limited resources to interdiction and tactical support aircraft because of the risk to ground assault upon the outbreak of war in Europe.)[42]

In the years after the First World War, wargaming remained a valuable training tool. During games, commanders stressed the importance of a proper commander's estimate of the situation using imperfect information, logical decision-making, orders writing, and coherent communication of those orders.[43] A game director would conduct a thorough after-action review with participants to discuss what drove commanders' decisions during the game and offer alternate solutions. After the group adjourned, the game director worked with senior wargame participants to draft reports that identified issues for subsequent exploration in follow-on experiments, live-force exercises, and other wargames.[44]

To complement insights gained from gaming, senior officers also used "operational mission" (*Operativ Aufgaben*) games to examine future hypothetical war scenarios.[45] Led by senior officers within the Troop Office (or *Truppenamtreise*, the *Reichswehr*-era "general staff" entity), up to 300 officers from group commands, divisions, and the schoolhouses collaborated on a potential solution that was written as a study and submitted to the *Truppenamtreise* for review. In 1931, one such exercise examined a war with France and Czechoslovakia. Two others in 1932 outlined a campaign against Poland.

German interwar-years gaming enjoyed high-level support, cultural acceptance, and a shared mental model about the next Great War. Training and education that used wargames at the *Kriegsakademie* laid the foundation for officers to continue the practice at their units later in their careers. Believers such as Von Seeckt, Halder, and Beck integrated wargaming into strategic decision-making for the institution. In the supporting establishment, senior officers

continued to wargame institutional issues such as doctrine, resourcing, and manufacturing of capabilities to fulfill projected future *Wehrmacht* requirements for the next war. German officers utilized wargames to first explore hypothetical strategic and operational dilemmas, then used lessons-learned to better understand campaign plans that served as the opening salvo of Germany's *Blitzkrieg* in the European theater. Gaming fostered an environment that encouraged subordinate leaders to adapt, innovate, and develop creative solutions.

Lessons from Japan: Ugaki, Midway, and the Carriers That Wouldn't Sink

The German example demonstrates wargaming's promise as a learning and rehearsal tool, but lessons from the Japanese experience highlight potential pitfalls when the tool is misapplied, misinterpreted, or abused to support a predetermined outcome. The Japanese example highlights the benefits of integrating wargaming into the professional development of officers in the schoolhouse, but it also illustrates the potential dangers of unrealistic play and obfuscation of game outcomes.

Japanese planners examining the Pacific theater determined that a bold campaign that relied upon speed, surprise, and near-perfect synchronization would be necessary against American, British, and Dutch forces in Southeast Asia and western Pacific to establish strategic conditions favorable to the Japanese at the onset of hostilities.[46] Games played a crucial role in supporting Japanese assumptions about the Pacific campaign. Admiral Isoroku Yamamoto, commander-in-chief of the Combined Fleet, directed wargames to support planning for the pivotal campaigns at Pearl Harbor in 1941 and Midway Island in 1942. By the beginning of the interwar period, officers learned gaming at the Japanese War College and Naval War College, just as German military officers did at the *Kriegsakademie*. Japanese naval officers first wargamed an attack on Pearl Harbor in 1927, when carriers and carrier-aviation capabilities were

in their infancy. During these games, two Japanese aircraft carriers (the only ones available in the fleet at the time) supported by an advance guard of submarines, destroyers, and cruisers inflicted only minimal damage on the US Pacific Fleet. Observers criticized the Japanese naval force commander's decision to attack Pearl Harbor for being rash.[47] Japanese officers continued to wargame to support planning as the army expanded operations into Manchuria and China, and planners intensified the practice starting in 1937 when they started shaping a campaign to defeat British forces in the South China Sea.[48]

Wargames played an integral part of Japanese war planning, with the Navy hosting a series of games prior to the opening campaigns in the Pacific theater. These games included a theater-level wargame that examined the Army and Navy's opening campaigns in the Aleutian Islands, Pearl Harbor, and the Southwest Pacific, as well as operational- and tactical-level wargames that focused on specific parts of the operations.[49] Fleet commanders and selected staffers participated in several secret games held in fall 1941 in preparation for the Pearl Harbor attack, as well as a series of games played in early 1942 before Japanese attacks across the Philippines, the Aleutian Islands, Guam, the Dutch East Indies, Singapore, and Hong Kong that ultimately stymied US and other allied forces across the region.

Planners used wargames conducted in the fall of 1941 at the Japanese War College to analyze the effectiveness of a surprise attack on the US Pacific Fleet in Pearl Harbor, as well as allow commanders and planners to rehearse the operation. For the Pearl Harbor wargames, Yamamoto handpicked his participants, which included fleet commanders and their staff.[50] Yamamoto wanted the wargames to generate insights about three critical decisions as part of the attack. First, he wanted to determine the feasibility of the operation. Second, Yamamoto wanted to figure out if the fleet could achieve surprise in the attack. Third, he wanted to examine an

optimal route for the approach of the carrier strike group toward Hawaii.[51] Commander Minoru Genda, a trusted confidant of Yamamoto who served as an air officer of the carrier task force that would attack Pearl Harbor, said that the Pearl Harbor wargames "clarified our problem and gave us a new sense of direction and purpose. After they were over, all elements of the Japanese Navy went to work as never before, because time was running out."[52]

Japanese wargames also had vocal critics. Genda's direct superior and the commander of the Pearl Harbor strike force, Admiral Chuichi Nagumo, expressed skepticism about the games' insights about likely Japanese success against the American Fleet. Yamamoto favored a bold attack against the US Pacific Fleet and overruled Nagumo's chief concern – that massing six aircraft carriers for the Pearl Harbor task force put a significant amount of overall Japanese naval combat power at risk.[53] Vice Admiral Hansaku Yoshioka, among the participants of the Pearl Harbor games, decried the inflation of Japanese capabilities, underestimation of American forces, and umpire decisions that were slanted in favor of the Japanese.[54] The games "epitomized the Japanese penchant for short-sighted, self-indulgent thinking," Yoshioka told American interrogators following the war.[55] World War II scholars believe this "self-indulgence" came back to haunt the Japanese during wargames before the Battle of Midway, when the Midway game series director, Admiral Matome Ugaki, overturned umpires' rulings about the sinking of two Japanese carriers by American land-based bombers. Ugaki reduced the number of sinkings to one carrier and allowed the other to participate in the next part of the game – invasions of New Caledonia and Fiji Island.[56]

Wargaming professionals often cite Ugaki's umpiring during the Midway wargame as a prime example of a good wargame undermined by leaders with a deterministic bias, but the reality is that wargaming has limitations.[57] A wargame is a good tool to examine decision-

making, establish principles, develop insights, and recommend areas for further study. It is not a

good tool for predicting the future or generating hard data. In *The Art of Wargaming*, Dr. Peter

Perla reasons that while the Japanese Midway games were "almost certainly biased," the point

that is often overlooked is that the game "raised the crucial issue of the possibility of an ambush

from the north; the operators ignored the warning, a warning reiterated by the oft-maligned

Ugaki."[58] This fact suggests that changing the umpires' ruling of the effectiveness of land-based

bomber attack was not necessarily willful ignorance, since B-17s had attacked the Japanese

carrier task force on several occasions and failed to score a single hit. Perla writes, "Ignoring or

changing the results of a few die rolls did not constitute the failure of Japanese wargaming in the

case of Midway; ignoring the questions and issues raised by the play did."[59] In this case, the

wargame generated an insight that key leaders of the actual Midway campaign overlooked.

Other Japanese planners believed the principal failure of the game was the "uncharacteristic"

play of Captain Chiaki Matsuda, the Japanese officer who role-played as the American

commander.[60] In post-war interviews, Genda suggested that Matsuda mirror-imaged Japanese

behavior onto the American fleet when it did not sortie for a decisive battle. "His (non-

American) conduct of the wargames might have given us the wrong impression of American

thinking," Genda told interrogators.[61]

Much like their German counterparts, Japanese planners during the interwar period

integrated wargames into campaign planning. However, the primary difference appeared to be

how the game's sponsors and stakeholders interpreted the game outputs. In the Midway games,

biases, poor assumptions, and preconceived notions caused analysts to overlook critical insights

and misinterpret game play.[62] Like the German wargame from the 1940 France campaign, which

was notable for its honest portrayal of the Allied commander, Japanese wargames also show the

importance of accurate, balanced "Red" play: the game must provide a correct picture of an adversary's capabilities and limitations, then honestly portray how the enemy would fight in a given situation and environment.

Lessons from America: Newport, Carrier Aviation, and the Pacific Campaign

Nimitz understood the challenges of a war in the Pacific thanks to his experiences as a student in the game rooms of the Naval War College. So had Ernest King, William Halsey, and Raymond Spruance – future admirals who commanded task forces, groups, and numbered fleets in the Pacific against Japan.[63] In the two decades between the world wars, US Navy officers cycling between the Naval War College, the operating forces, and influential supporting-establishment institutions generated a shared mental model that focused on the challenges of an impending Pacific campaign against Japan. With the specter of another global conflict on the horizon, they participated in wargames, studies, and exercises in the 1920s and 1930s to explore the wide array of conceptual, operational, and tactical challenges that the bloody stalemate of First World War exposed.

The Naval War College is the most well-known illustration for American military gaming between the First and Second World Wars. Newport fully embraced wargaming by integrating it into officer PME curricula as the Germans did at the *Kriegsakademie.* The Newport wargames helped bolster student and instructor understanding about the challenges of operating in the Pacific against the Japanese, and informed studies and exercises for emerging capabilities such as naval aviation, which proved pivotal during the Second World War.

The Naval War College worked with the Navy's General Board on future planning scenarios based on various competitors and capabilities. Officials assigned each scenario a color, including Plan Orange for a war with Japan, which formed the basis of many of the games

played by students in Newport.[64] Like other Naval War College students, Nimitz wargamed and

studied these operational dilemmas during the 1922-23 academic year. In his thesis, Nimitz

described the need for seizing advanced bases or developing an at-sea refueling and

replenishment capability "to maintain even a limited degree of mobility" against the Japanese.[65]

"To bring such a war to a successful conclusion BLUE must either destroy ORANGE military

and naval forces or effect a complete isolation of ORANGE country by cutting all

communication with the outside world," wrote Nimitz, referring to the color code-names for the

United States and Japan, respectively. "It is quite possible that ORANGE resistance will cease

when isolation is complete and before steps to reduce military strength on ORANGE soil are

necessary. In either case the operations will require a series of bases westward of Oahu, and will

require BLUE Fleet to advance westward with an enormous train, in order to be prepared to seize

and establish bases enroute."[66] Thus, original conceptions of the Pacific campaign featuring the

Pacific Fleet's advance along extended sea lines of communication gave way to an island-

hopping approach that allowed American forces to establish advance bases from which to launch

air attacks against the Japanese home islands.

At the Naval War College, wargaming enjoyed a powerful benefactor in Admiral

William Sims, who commanded US Naval Forces in Europe during the First World War and

began a second stint as president of the Naval War College in 1919. He possessed recent combat

experience, knowledge of wargaming from his first term as the college's president, and a sense

of urgency to provide future leaders with more opportunities to test their combat decision-

making skills and inform future naval innovation.[67] Sims regularly highlighted gaming's role in

a naval officer's professional development:

> The principles of wargames constitute the backbone of our profession. … In no other way
> can this training be had except by assembling about a game board a large body of

experienced officers divided into two groups and 'fighting' two great modern fleets against each other – not once, or a few times, but continually until the application of the correct principles becomes as rapid and as automatic as the plays of an expert football team.[68]

The War Plans Division of the US War Department gamed elements of American mobilization plans prior to the start of the Second World War, but the national PME institutions embraced gaming as an analytical tool, and none more enthusiastically as the Naval War College.[69] Of more than 300 wargames conducted in Newport during the interwar period, about half focused on campaigns and tactics while the other half gamed theater-wide strategy. Among approximately 150 strategy games, all but 9 explored a possible war with Japan.[70]

During games, students prepared plans based on a given scenario. Using their plans as a guide, players manipulated miniature ships on large maps depicting oceans of the world. Participants and umpires consulted charts and tables to determine game-move outcomes based on desired operational and tactical actions. During some games, students playing "Blue" – the United States – prepared and executed plans against classmates who attempted to mimic the doctrine and capabilities of the adversary – eventually Japan. In some cases, game directors ordered the players to switch sides and execute the plans prepared by their opponents.[71] Tactical games proved useful in understanding and testing doctrines for ship movements, particularly the employment of carriers and their supporting vessels.[72]

The college worked closely with planners at the Office of the Chief of Naval Operations (OpNav) to incorporate elements of Plan Orange into the wargames. College officials sent game insights to OpNav, which integrated them into the design of the fleet problems.[73] The fleet tested the ideas generated by the wargames during the exercises, the results of which planners sent back to Newport to inform subsequent wargames. "Thus, ideas developed or problems encountered on the game floor were often examined during the fleet problems and vice versa," wrote Alfred

Nofi.[74] For example, during Fleet Problem VII in 1927, war college students played a scenario identical to one being used by naval, air, and ground forces exercising in Rhode Island Sound and adjacent coastal areas.[75]

The relationship among Newport's wargames and subsequent analyses and exercises proved particularly valuable for the maturation of carrier aviation.[76] In the 1920s, carrier aviation concept development began at the war college, where students and faculty used games to study existing and possible doctrine for fleet employment.[77] The fleet took inferences drawn from the games and operationalized them in maneuvers and mock battles during the fleet problems. Analysts provided an honest evaluation of the exercise results back to the technical bureaus (particularly the Bureau of Aeronautics) and the war college, and the college refined subsequent wargames to reflect insights generated by the exercises.[78] This feedback loop contributed to the realism and creativity of game play at Newport and ultimately led to conclusions about the massing of aircraft for strikes and the need for a coherent air defense plan that integrated anti-air artillery and defensive interceptors during the Second World War.[79]

It is important to note that the wargames did not reveal the exact force structure, concepts, capabilities, tactics, techniques, and procedures that the US Navy used to defeat Japan. Instead, the games gave American naval officers the analytic space to think and explore those issues. As the Pacific war proceeded, the US Navy adjusted well to the changing realities of the conflict. John Kuehn wrote that the type of navy that America needed "had already been discussed and thought about extensively during the hearings of the General Board, in the classrooms at the Naval War College, at sea, and in the planning cells of OpNav's War Plans Division. … Applying existing strategic, operational, and tactical solutions and then adjusting them to the realities of war came easier to Navy officers because of their focus over two decades

on precisely the strategy and materiel requirements that a Pacific War without preexisting bases demanded."[80]

For the Americans, wargames allowed planners to explore evolving concepts and shape capabilities, as well as understand the operational challenges of the impending Pacific campaign. To develop new capabilities, wargames supported a cycle of research that informed analyses and live-force exercises in a continual feedback loop. This process reinforced realism in subsequent games and exercises, and a well-informed officer corps that tested and evaluated both types of evolutions. To develop a better understanding of Plan Orange, the Naval War College served as an incubator for creative ideas on how to overcome operational challenges in the Pacific. Through game play, officers learned how to fight against the Japanese, as well as how the Japanese fought. Students who cycled through the game floor at Newport developed a shared mental model that they carried with them to the fleet and eventually to war.

Part III: Insights and Recommendations

The militaries of Germany, Japan, and the United States utilized gaming between the First and Second World Wars to help them overcome challenges relating to doctrine, organization, training and education, and capabilities development. The Versailles Treaty prohibitions prompted Germany to use means other than live-force exercises to study and mature its combined arms concept, test naval and air doctrine, and drive planning for the invasions of Poland, France, and the Low Countries in the European theater. Japan effectively used wargames to inform doctrine and war planning, but biases affected game outcomes and subsequent planning of future campaigns, particularly the Battle of Midway. Japan gamed both strategic and tactical elements of its ambitious Pacific campaign, studying in detail essential tasks as part of its Pearl Harbor and Midway operations plans. Game insights prompted planners

to change parts of its Pearl Harbor attack, but failed to sway leaders to examine more closely a critical element of the Midway campaign. The United States, particularly the Navy, combined wargaming with analyses and live-force exercises to study upcoming likely threats and advance naval concepts and capabilities such as carrier aviation. In the United States, Naval War College games of different variations of Plan Orange exposed officers to the theater, operational, and tactical challenges of a conflict against Japan. Many games played over the years between the world wars created a baseline of understanding about how naval officers would fight when war broke out. Now, nearly a century later, today's US military should apply best practices from those interwar years to spur innovation and overcome the kinds of strategic, operational, and institutional challenges that plagued these adversaries before the Second World War. The following recommendations, taken from effective practices of this period, leverage wargames as a tool today to provide a strategic edge for the US joint force tomorrow.

First, the US military must expand and deepen the use of wargaming at PME institutions as a training and educational tool. Similar to the interwar period, wargames should be used to train officers to make decisions from a commander's perspective, gain insights into likely adversaries, and learn about the war plans to counter or defeat them. Wargaming design should be part of the regular curriculum to reinvigorate this technique within the uniformed military, since PME institutions are intended to broaden officers' professional horizons and allow them to explore new ideas.[81] At the interwar-period *Kriegsakademie*, some students had never experienced the brutal combat of World War I and never faced decision-making under fire. Wargaming woven throughout the curriculum gave these future leaders an opportunity to practice "commandership" from the commander's perspective. Thus, students playing in wargames estimated situations based on given scenarios, outlined courses of action after

assessing situations, executed plans, and then absorbed honest critiques of their decisions. In the 1920s and 1930s at the Naval War College, students also received a primer in commandership against the backdrop of a Pacific naval campaign. The students who played the games, as well as the faculty members who designed and umpired these events, shaped and fed a shared mental model about the strategic, operational, and tactical challenges of fighting the Japanese in the coming war. Officers returning to Newport as faculty members brought with them recent operational experiences, including fleet experiments that shaped carrier aviation and informed the requirements of new capabilities.

Beyond the Naval War College and the Naval Postgraduate School in Monterey, California, current US PME students are not taught how to plan and develop wargames as part of their regular course work.[82] At US Marine Corps University, for instance, wargaming is taught during a six-week elective at Command and Staff College (if enough students express interest in the elective), but the course fails to relate how games are relevant to real-world war planning and critical US defense processes such as capabilities development. At the next-level PME institution, students of the Marine Corps War College (lieutenant colonels and commanders) participate in a wargame as part of the curriculum's Joint Professional Military Education II (JPME II) requirement, but they are never taught how to plan, execute, and analyze a game themselves. Within the Air Force, the Air Force Materiel Command offers three-day introductory courses with curricula tailored to the needs of a client command or organization, but these courses fall short of the integral nature that wargaming fulfilled for the German Army, Japanese Navy, and US Navy during the interwar years.[83]

To yield substantive benefits, wargaming must be integrated into service PME starting with captain-level career courses. The first exposure should be at the rank of captain in order to

give young leaders intensive, virtual decision-making experience before they assume company

command. Company command is the appropriate time to introduce gaming to an officer's

development because his unit gets four times larger (a Marine rifle company has 182 personnel

by table of organization, compared to 43 personnel in a Marine rifle platoon) and he must have

the mental acuity and confidence to operate without constant supervision from superiors.

Gaming gives leaders this experience.

As an officer's career progresses, the wargaming curriculum should teach students how

to develop, plan, and execute wargames on a larger scale. At top-level schools, an officer should

be expert at applying game insights into the vast US military bureaucracy, feeding future-leaning

commands and organizations within the supporting establishment that play a key role in

developing future strategies, concepts, capabilities, and resource allocations. With its emphasis

on decision-making and reflection on the implications of those decisions, wargaming provides a

tool to foster imagination and intellectual growth inside and outside a formal schoolhouse

setting. Teaching wargaming design to uniformed military members empowers them to create

the intellectual venues themselves when they return to the fleet, flight line, or field – much like

the officers of the Germany Army, Japanese Navy, and American Navy did during the interwar

period.

Second, the US military should more closely bind service-level wargaming, analysis, and

live-force exercises to provide the intellectual and practical test beds to explore and develop new

concepts, capabilities, and technologies to overcome unforeseen warfighting challenges. The

games and exercises should be conducted as distinct events that are separated by weeks or

months, unlike the infamous *Millennium Challenge 2002* event, which attempted to synchronize

a wargame, experiments, and exercises involving live forces around the world.[84] Wargames,

analysis, and exercises are complementary elements of a cycle of research that offered fresh approaches and shaped new capabilities during the interwar period.[85] Wargaming provides an environment for players to make decisions and understand their implications without expending blood or treasure. Insights derived from games are generally qualitative in nature. Analysis uses mathematical tools – primarily computer-generated models in today's military – in an attempt to duplicate the physical processes of combat. Insights derived from analysis are usually quantitative in nature. Both wargames and analysis, however, are only abstractions of reality.[86] Together, they can inform exercises that give real forces the opportunity to implement in the physical domain the new approaches and ideas suggested by wargames and analysis. (See *Table 1, Comparison of Campaign Analyses and Wargames*.)

Comparison of Campaign Analyses and Wargames

	Campaign Analyses	Wargames
Objectives	Quantitative insights into feasibility, critical physical factors	Training; exploring decision-making
Event Sequence	Preordained	Dynamic
Engagement Outcomes	Typically expected value	Usually stochastic
Learning	Iterate until balanced outcomes	Few second chances
Interpret	Results	Processes
Participants	Primarily civilians with military advice	Primarily military in military roles

Source: Peter Perla, "Wargames, Analyses, and Exercises, *Naval War College Review*, Spring 1987: 48, Table 1.

Table 1. Attributes of campaign analyses and wargames.

US Navy Commander Phillip Pournelle writes that each of the tools "suffer from their

own biases, simplifications, and cognitive and epistemological shortcomings. When integrated

judiciously, however, the cycle of research gives leaders at all levels critical facts, synthetic

experiences, and opportunities to rehearse a range of events in their minds and in the Fleet or the

field." (See *Table 2, Comparison of Exercises and Wargames*.)

Comparison of Exercises and Wargames

	Exercises	Wargames
Activity	Operation of actual forces	Simulation of operations
Goals	Training; evaluating performance	Training; exploring decision processes
Cost	Expensive	Relatively inexpensive
Time Scale	Real time	Adjustable
Flexibility	Resource-constrained; limited by availability of forces	Requires relatively few resources; may be played nearly anytime or anywhere
Levels of Play	Primarily tactical with limited operational	Tactical, operational, and strategic – all possible
Participants	Military; seldom highest ranks	Both military and civilian; seldom highest ranks
Results	Quantitative measures of performance	Qualitative measures of decisions

Source: Peter Perla, "Wargames, Analyses, and Exercises, *Naval War College Review*, Spring 1987: 50, Table 2.

Table 2. Attributes of exercises and wargames.

The cycle of research has increased momentum at the Marine Corps Warfighting

Laboratory's (MCWL) Ellis Group, which hosts weekly wargames to examine emergent Marine

warfighting challenges. The games serve as an incubator for concepts and capabilities under

development. During a game in 2015, dozens of uniformed officers and civilian experts gathered

around a large sandtable separated by a barrier. A young Marine infantry captain explained how

he planned to land his company. On the other side of the barrier, red cell members determined

how they would oppose the landing. On the group's periphery, analysts recorded observations

made by the participants. Scribes filled whiteboards with insights from the game, which they matched against the command's prioritized list of warfighting challenges. US Marine Corps Brigadier General Dale Alford, MCWL's commanding general, adopted the weekly games after observing the Naval War College's Halsey Groups use operations analysis and wargaming to examine naval warfighting challenges. "It was mostly about getting the right people involved and in the same room," he said.[87]

Third, wargaming leaders must ensure an accurate and intellectually honest representation of the enemy. Most games played by the Germans, Japanese, and Americans during the interwar period featured two sides: friendlies and adversaries playing against one another. Some of today's large service-level games are one-sided, with friendly "blue" actions being played against pre-scripted enemy reactions or a control group attention divided between representing "red" and running the overall event. However, if war is "an act of force to compel our enemy to do our will," as Carl von Clausewitz suggested in *On War*, these games must adequately portray the adversary's will.[88] One-sided wargames lose the essence of the opposing will when the enemy's actions are not represented by another human being seeking to win. Retired US Marine Corps Lieutenant General Paul Van Riper, who previously served as director of Command and Staff College, required all Command and Staff College games to be two-sided affairs. "You need two free-thinking wills … within the bounds of the problem," said Van Riper, who has consulted on many joint and service games since his retirement from active duty in 1997 and served as the red cell commander during the *Millennium Challenge* event.[89]

This honest portrayal goes beyond using an expert versed on enemy (e.g., "red cell") capabilities, limitations, and doctrine. During the *Wehrmacht* wargames before the invasion of France and the Low Countries, the red cell correctly suggested that French-led Allied Forces

would be slow to respond to a German main effort thrust through the Ardennes – prompting planners to shift resources to the army group approaching from the forest. The red cell did not portray an idealized version of the French doctrinal response, which would likely have prompted German planners to shift resources to a different army group and resulted in a different course of action. From the Japanese wargames before the Battle of Midway, historians and professional gamers often cite the sinking – and revival – of two Japanese carriers as an admonition against biases, poor assumptions, and predetermined outcomes.

Fourth, future wargaming efforts should use different types of games for different purposes and desired outcomes. A greater variety of games can attack a problem from different perspectives. A larger number of games provides more opportunities to create fresh solutions.[90] For a new, evolving subject, a wargame with more seminar discussion, less action-counteraction play, and fewer rules might be more appropriate in order to generate player insights and spur creativity. On a topic for which much is already known, a wargame with less seminar discussion, more action-counteraction play, and more rules based on hard data might be more suitable to refine players' understanding of capabilities.

Conclusion: Back to the Future

The German Army, Japanese Navy, and US Navy used wargaming to shed light on strategic, operational, and tactical uncertainty during the interwar period. In the German Army, wargaming formed the bedrock for the education of officers and provided opportunities for commanders and staffs to rehearse complicated operations such as the offensive against France and the Low Countries in 1940. For the Japanese Navy, planners utilized wargames to examine different ways to employ the Combined Fleet in the opening salvo of the Pacific campaign. The Germans successfully used red cells during their wargames to accurately and honestly portray

French forces' actions during the 1940 campaign, while the Japanese demonstrated the dangers of predetermined notions during wargames before the Battle of Midway. The US Navy found wargaming to be an effective tool for educating officers as well, inculcating the practice among generations of officers who attended the Naval War College and fostering a shared mental model through hundreds of wargames that focused on a potential future war with Japan. Likewise, American naval officers also wargamed carrier aviation, discovering optimal ways to employ forces that massed firepower and extended the reach of the Pacific Fleet. These insights fed the cycle of research that allowed American naval officers to study, experiment, and develop new concepts and capabilities leading up to the Second World War.

Interwar-period wargaming provided users with a chance to shed light on an opaque future. Although the threats are different, senior US defense leaders face similar ambiguity now. The reassertion of Russia in world affairs, a militarily stronger China, and a multitude of powerful non-state actors have dramatically changed the strategic landscape. Fast-developing capabilities, nascent technologies, unmanned weapons platforms, 3D printing, and human-machine interfacing are among the potential factors of the next great conflict. With no cost in blood and minimal in treasure, wargames can empower US military leaders to exert intellectual leadership and innovate to be better prepared for the future.

Appendix A: Wargames and Shared Mental Models

Carl von Clausewitz writes that war is an interactively complex system featuring actors, relationships, and activities that work with a particular logic.[91] A wargame is a type of interactive mental model that represents potential outcomes, guides a commander's actions in the real world, and fosters learning within his organization. Wargaming allows a commander to fail, adapt, and succeed against wicked problems in a synthetic environment without wasting precious blood or treasure. In the form of a simulation, wargames provide participants with the analytic space to examine a situation's logic by reasonably representing the actors, their interactions and relationships, and motivations driving their actions within an object system.[92]

The process of developing a wargame's logic and analyzing its results resembles the activities of operational design. John Schmitt writes that design consists of seven related activities.[93] First, the design team gains an appreciation of the situation, gathering different perceptions of the current state to form as complete a picture as possible of the current circumstances. Second, designers attempt to identify the problem and shape its structure. Third, the design team identifies and defines the object system, establishing which factors comprise the system the design team intends to transform. Fourth, designers sketch a system model that explains the problem, including root causes and dynamics among the actors. Fifth, the design team identifies possible ways to transform the system. Sixth, designers translate the abstract system interventions into real-world actions, the logic of which will inform planning and execution. Seventh, the team identifies information needed to prove or disprove its design hypothesis, while executors implement a solution that eventually changes the situation and renews the design cycle.

As with operational design, wargame planners use game mechanics, scenario-building, and analysis to form an interactive mental model. The key to developing that mental model is discourse. Discourse frames the topic and objectives, identifies critical questions based on the game objectives, and establishes the logic of the subject system. During the game, opposing teams use their respective models to derive and implement a solution. Interactions between the teams manifest the dynamics of a chaotic, nonlinear system. After-action reviews highlight the significance of those dynamics and allows the participants to adjust solutions based on the disproportionate effect of relatively small inputs. As a result, a narrative emerges, forming the basis of a solution that participants judge to have the most potential for success.

The overarching concept for the wargame is the mental model. Mental models give commanders a cognitive representation of real or hypothetical situations based on a scenario. Individuals develop their own mental models to explain how the world works as explained through metaphors within that scenario.[94] Commanders and subordinates synthesize their perspectives into a shared mental model to enable collaboration on potential solutions.[95] As in real war, the model must capture the chaotic, nonlinear qualities of the scenario.

The fundamental process tying the stages of the game together is discourse. An iterative discourse allows the designers and players to frame the problem behind the game, develop the logic of the mental model for solving that problem, analyze the key interactions that arise during the implementation of the solution to the problem, make adjustments to the underlying logic, and develop an appropriate solution. Wargame planners build the logic of the game by establishing the terminology, symbology, and constructs the participants will use to replicate the object system. No model is perfect, but this methodology allows the design team to apply analytic rigor to each step of the process.

To frame the logic of the game, wargame planners develop a scenario. A scenario sets the wargame's timeframe; establishes force capabilities and posture; applies concepts and the doctrine forces use; and posits assumptions about the environment. Playing the game allows participants to explore the effects of those assumptions.

Within the wargame, an understanding of war as a chaotic, nonlinear system will allow designers and participants to identify the actors, relationships, and interactions that form a system. Assumptions about actors' interests and strategies may create small ripples with surprisingly outsized implications elsewhere in the system.[96] A wargaming approach based on an understanding of nonlinear systems acknowledges that the capabilities and interactions of friendly, enemy, and neutral forces can change over time, and frames problems with the understanding that assumptions and prospective tasks are as dynamic as they are in real war.[97]

After the game, analysis tells the system's story, or narrative. Analysts study game products, transcribed discussions, and other data generated during the game. Through discourse, participants extract a counterlogic that yields the essence of a potential defeat mechanism of the object system.[98] Analysts offer theses to explain the interactions and identify additional areas for subsequent exploration that can enrich understanding.

Chaos theory finds patterns of behavior in natural systems such as the weather and physics.[99] Likewise, a wargame played iteratively – with the identical design and scenario – may expose patterns of behavior within its simulated environment. New, unexpected patterns may emerge from these iterations to signal a significant change in the system.[100] Schmitt writes that every repetition "is an opportunity to learn more about the situation and make incremental improvements to the design."[101] Applied to wargaming, the iterative process allows every game to become an opportunity to expose flaws and improve the interactive mental model.

Wargames guide a commander's actions in the real world. Games cannot perfectly simulate reality or replicate the scope or scale of armed conflict, but they approximate its wicked problems meaningfully enough to shape a commander's conception of the system and allow him to derive possible solutions. Participants postulate closed-loop causal relationships that create outcomes based on the combinations of negative (balancing) and positive (reinforcing) feedback.[102] Through discourse, designers hypothesize a system's logic to explain how the system works and elicit a counterlogic intended to transform the system through action. The counterlogic informs subsequent operational planning.[103] Through feedback loops, gaming allows commanders to adjust how they interact within the system.[104] This kind of closed signaling loop forms the core of Norbert Wiener's Cybernetics concept, in which a system adjusts its behavior in some manner based on feedback it receives from the environment.[105]

Wargames also foster learning within an organization by allowing a shared mental model to change by design, instead of through drift or disruption.[106] Change by drift is incremental, based on real-world experiences. Change by disruption is traumatic, featuring a significant event that establishes a new mental model. Change through drift or disruption is less desirable because it occurs through interaction with the system. In war, this is a cost paid in men and materiel. However, adapting a mental model by design is purposeful – commanders and his subordinates proactively seek new ideas from the real world and synthetic experiences such as wargames, which offer potential solutions for subsequent study, experimentation, and exercising.[107] Thus commanders and planners using a systemic approach gain more opportunities to build adaptability into imperfect plans. Wargames also test a warfighting organization's espoused theory (what the organization says underlies perceptions and actions) against its theory-in-use

(what actually accounts for perceptions and actions). Within a synthetic environment, wargames help commanders identify, study, and adapt theories-in-use.[108]

A system-based approach to wargaming gives commanders the ability, however imperfect, to frame ill-structured situations, represent a system's logic, and extract a defeat mechanism informing operational planning. Wargames cultivate interactive mental models that allow participants to collaborate on their understanding of an object system and build feedback mechanisms that facilitate adaptability. Wargaming establishes a venue for iterative examination of war's unique, wicked problems from multiple perspectives.[109] No game is a perfect representation of a problem in the same way that every model of a wicked problem is incorrect.[110] However, each successive game gives players a fuller picture of its logic and potential solutions. When members of a design team achieve an understanding of the system, they also develop a better comprehension of the real world's complexity.

Endnotes

[1] Robert O. Work and Paul Selva, "Revitalizing Wargaming is Necessary to be Prepared for Future Wars," War on the Rocks blog, December 8, 2015 (accessed December 25, 2015). http://warontherocks.com/2015/12/revitalizing-wargaming-is-necessary-to-be-prepared-for-future-wars/.

[2] Francis J. McHugh, *Fundamentals of War Gaming* (Newport, RI: US Naval War College, 1961), 64.

[3] Peter Perla (research scientist at the Center for Naval Analyses), interview with Jeff Wong, October 9, 2015.

[4] Dr. Peter Perla is credited with first using the term "Cycle of Research" to describe how wargames, exercises, and operations research can mutually support military innovation. Contrast the cycle with the use of the same tools in isolation and independently. Peter Perla, *The Art of Wargaming* (Annapolis, MD: Naval Institute Press, 1990), 287.

[5] Williamson Murray and Allan Reed Millett, *A War to be Won: Fighting the Second World War* (Cambridge, MA: Harvard University Press, 2000), 2.

[6] Mental models are psychological representations of real, hypothetical, or imaginary situations. Princeton University, "Mental Models and Reasoning," (Princeton, NJ: Princeton University, 2016), accessed February 11, 2016: http://mentalmodels.princeton.edu/about/what-are-mental-models/.

[7] Older versions of *Joint Publication (JP) 1, Doctrine for the Armed Forces of the United States*, defined wargaming as "simulation, by whatever means, of a military operation involving two or more opposing forces, using rules, data, and procedures designed to depict an actual or assumed real-life situation." Peter Pellegrino, "What is War Gaming?" Lecture at the Naval War College, published December 20, 2012 (accessed December 26, 2015): https://www.youtube.com/watch?v=maHpGR-Vj4Q.

[8] US Department of Defense, *JP 1-02, Department of Defense Dictionary of Military and Associated Terms* (Washington, DC: US Department of Defense).

[9] Perla, *The Art of Wargaming*, 164.

[10] McHugh, *Fundamentals of War Gaming*, 2.

[11] Red "cells" and red "teams" are frequently confused for each other. A red cell is an entity typically led by a staff intelligence officer tasked with representing enemy doctrine and its likely courses of action. A red team is tasked with challenging perceived norms and assumptions made by a commander and his staff in order to improve the validity and quality of a plan.

[12] Headquarters, US Marine Corps, *MCDP 5-1, Marine Corps Planning Process* (Washington, DC: US Marine Corps, 2011), 1-5.

[13] Peter Pellegrino, "What is a War Game?" lecture, US Naval War College, published December 20, 2012 (accessed December 26, 2015).

[14] Ibid.

[15] Williamson Murray, "Red-Teaming: Its Contribution to Past Military Effectiveness," DART Working Paper 02-2 (McLean, VA: Hicks and Associates, September 2002), 20-21.

[16] Ed Offley, *Turning the Tide: How a Small Band of Allied Sailors Defeated the U-boats and Won the Battle of the Atlantic* (New York: Basic Books, 2012), 391-92.

[17] Milan Vego, "German War Gaming," *Naval War College Review* 65 no. 4 (Newport, RI: US Naval War College, Autumn 2012), 110.

[18] McHugh, *Fundamentals of War Gaming*, 39.

[19] David C. Evans and Mark R. Peattie, *Kaigun: Strategy, Tactics, and Technology in the Imperial Japanese Navy, 1887-1941* (Annapolis, MD: Naval Institute Press, 2012), 73.

[20] McHugh, *Fundamentals of War Gaming*, 57.

[21] Eric J. Madonia, "Preparing Navy Officers for Leadership at the Operational Level of War," paper for the Naval War College (Newport, RI: US Naval War College, March 5, 2010), 8.

[22] Vego, 110-111.

[23] Rudolf Hofman, "German Army War Games," Art of War Colloquium (Carlisle Barracks, PA: US Army War College, 1983), 6.

[24] Vego, 114.

[25] Ibid.

[26] US Marine Corps University, "About Exercise Nine Innings," (Quantico, VA: US Marine Corps University), July 20, 2015 (accessed March 8, 2016): http://guides.grc.usmcu.edu/9innings2015.

[27] Ernest R. May, *Strange Victory: Hitler's Conquest of France* (New York, NY: Hill and Wang, 2000), 258.

[28] Perla, *The Art of Wargaming*, 42.

[29] Phillip S. Meilinger, *The Paths of Heaven: The Evolution of Airpower Theory* (Maxwell Air Force Base, AL: School of Advanced Airpower Studies, 1997), 171.

[30] Vego, 130-131.

[31] May, *Strange Victory*, 465

[32] Ibid, 258.

[33] Ibid, 465.

[34] Ibid, 263.

[35] *Auftragstaktik* is an approach to command in which a commander issues to a subordinate an intent for a given mission, and the subordinate is given the freedom to independently plan and execute the mission. This mindset gave subordinates flexibility in deciding how to accomplish an assigned mission within the framework of the intent. Michael D. Krause, "Moltke and the Origins of the Operational Level of War," *Historical Perspectives of the Operational Art,* Michael D. Krause and Cody R. Phillips, eds. (Washington, DC: Center for Military History, 2005), 141.

[36] Karl-Heinz Frieser, "Panzer Group Kleist and the Breakthrough in France," *Historical Perspectives of the Operational Art*, Michael D. Krause and Cody R. Phillips, eds. (Washington, DC: Center for Military History, 2005), 173.

[37] Ibid, 175-176.

[38] Ibid, 176.

[39] May, *Strange Victory*, 459.

[40] Vego, 115.

[41] Jonathan M. House, *Toward Combined Arms Warfare: A Survey of 20th-Century Tactics, Doctrine, and Organization* (Fort Leavenworth, KS: US Army Command and General Staff College, 1984), 52.

[42] Meilinger, *The Paths of Heaven*, 173.

[43] Vego, 115.

[44] Ibid, 129.

[45] Ibid, 117.

[46] Evans and Peattie, *Kaigun: Strategy, Tactics, and Technology in the Imperial Japanese Navy, 1887-1941*, 469-470.

[47] Martin Van Creveld, *Wargames: From Gladiators to Gigabytes* (Cambridge: Cambridge University Press, 2013), 168.

[48] Ibid, 167.

[49] Ibid.

[50] Gordon W. Prange, *At Dawn We Slept: The Untold Story of Pearl Harbor* (New York, NY: Penguin Books, 1991), 225.

[51] Ibid.

[52] Ibid, 234.

[53] Thomas B. Allen, "The Evolution of Wargaming: From Chessboard to the Marine Doom," in *War and Games*, ed. Timothy J. Cornell and Thomas B. Allen (San Francisco, San Marino: Center for Interdisciplinary Research on Social Stress, 2002), 234.

[54] Prange, *At Dawn We Slept*, 234.

[55] Ibid.

[56] McHugh, *Fundamentals of War Gaming*, 40.

[57] Ibid.

[58] Perla, *The Art of Wargaming*, 47.

[59] Ibid.

[60] Ibid.

[61] Gordon W. Prange, Donald M. Goldstein, and Katherine V. Dillon, *Miracle at Midway* (New York, NY: McGraw Hill, 1982), 35-36.

[62] Ibid.

[63] Allen, "The Evolution of Wargaming," 233-234.

[64] Edward S. Miller, *War Plan Orange: The US Strategy to Defeat Japan, 1897-1945* (Annapolis, MD: Naval Institute Press, 1991), 2.

[65] Murray, "Red-Teaming: Its Contribution to Past Military Effectiveness," 42.

[66] Chester Nimitz, "Thesis on Tactics," written for his master's thesis at the Naval War College (Newport, RI: Naval War College, 1923), 35.

[67] Admiral Sims is also the only active-duty US naval officer to receive the Pulitzer Prize. During his second tour as the Naval War College president, he wrote *Victory at Sea* and won for history writing.

[68] McHugh, *Fundamentals of War Gaming,* 64.

[69] Students at the Army War College, Army Command and General Staff College, and Marine Corps Command and Staff College also participated in wargames during the interwar period. McHugh, *Fundamentals of War Gaming*, 53.

[70] Van Creveld, *Wargames*, 166.

[71] McHugh, *Fundamentals of War Gaming,* 53.

[72] Van Creveld, 166.

[73] John T. Kuehn, *Agents of Innovation: The General Board and the Design of the Fleet That Defeated the Japanese Navy* (Annapolis, MD: Naval Institute Press, 2008), 12-13.

[74] Alfred A. Nofi, *To Train the Fleet for War: The US Navy Fleet Problems, 1923-1940* (Newport, RI: US Naval War College Press, 2010), 20.

[75] Ibid.

[76] Williamson Murray, "Innovation: Past and Future," in *Military Innovation in the Interwar Period*, eds. Williamson Murray and Allan R. Millett (New York, NY: Cambridge University Press, 1996), 316.

[77] Kuehn, *Agents of Innovation*, 13.

[78] Thomas C. Hone, Norman Friedman, and Mark D. Mandeles, "Innovation in Carrier Aviation," *Naval War College Newport Papers 37* (Newport, RI: US Naval War College Press, August 2011), 157-158.

[79] Murray, "Innovation: Past and Future," 316-317.

[80] Kuehn, *Agents of Innovation*, 178.

[81] Commander Phillip Pournelle, USN (analyst at the Office of Net Assessment, Office of the Secretary of Defense), interview by Jeff Wong, September 24, 2015.

[82] As discussed previously, wargaming is different from COA Wargaming, which is a phase of the joint and services' planning processes, e.g., the Military Decision-Making Process and Marine Corps Planning Process.

[83] Colonel Matthew Caffrey, USAF (Retired) (wargame instructor at the Air Force Materiel Command), interview by Jeff Wong, October 15, 2015.

[84] Gary Anderson and Dave Dilegge, "Six Rules for Wargaming: The Lessons of Millennium Challenge '02," *War on the Rocks*, November 11, 2015 (accessed April 1, 2016): http://warontherocks.com/2015/11/six-rules-for-wargaming-the-lessons-of-millennium-challenge-02/.

[85] Philip Pournelle, "Preparing for War, Keeping the Peace," *Proceedings* 140, no. 9 (Newport, RI: US Naval Institute, September 2014), accessed October 15, 2015: http://www.usni.org/magazines/proceedings/2014-09/preparing-war-keeping-peace.

[86] Perla, *The Art of Wargaming*, 287.

[87] Brigadier General Dale Alford, USMC (commanding general of the Marine Corps Warfighting Laboratory), interview by Jeff Wong, November 23, 2015.

[88] Carl von Clausewitz, *On War* ed. and trans. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1984), 75.

[89] Lieutenant General Paul Van Riper, USMC (Retired) (faculty member at Marine Corps University), interview by Jeff Wong, February 2, 2016.

[90] Pournelle, interview by Jeff Wong, September 24, 2015.

[91] Clausewitz, *On War*, 605.

[92] John Schmitt, "A Systemic Concept for Operational Design" concept paper written for US Marine Corps Combat Development Command (Quantico, VA: US Marine Corps Combat Development Command, 2006), 25-26.

[93] Schmitt, "A Systemic Concept for Operational Design," 20-22.

[94] Ibid, 51.

[95] William Vivian, "Sustaining Competitive Advantage: Mental Models and Organizational Learning for Future Marines," Future War Paper for the School of Advanced Warfighting, Marine Corps University (Quantico, VA: Marine Corps University, 2007), 2.

[96] Robert Jervis, *System Effects: Complexity in Political and Social Life* (Princeton, NJ: Princeton University Press, 1997), 9.

[97] Schmitt, 17.

[98] Ibid.

[99] James Gleick, *Chaos: Making a New Science* (New York: Penguin Books, 1988), 7-9.

[100] Albert-Laszlo Barabasi, *Linked: How Everything Is Connected to Everything Else and What It Means for Business, Science, and Everyday Life* (New York, NY: Plume, 2003), 12.

[101] Schmitt, 17.

[102] Vivian, "Sustaining Competitive Advantage," 24.

[103] Schmitt, 16.

[104] Gleick, *Chaos: Making a New Science*, 141.

[105] Antoine Bousquet, "Chaoplexic Warfare or the Future of Military Organization," *International Affairs 84,* no. 5 (London, UK: Royal Institute of International Affairs, September 2008), 926.

[106] Vivian, 3-4.

[107] Ibid.

[108] Vivian, 2.

[109] War's "violence is not of the kind that explodes in a single discharge, but is the effect of forces that do not always develop in exactly the same manner or to the same degree. At times they will expand sufficiently to overcome the resistance of inertia or friction; at others they are too weak to have any effect. War is a pulsation of violence, variable in strength and therefore variable in the speed with which is explodes and discharges its energy." Clausewitz, *On War*, 87.

[110] Models are useful metaphors that provide only a representation of reality. Michael P. Marks, *Metaphors in International Relations Theory* (New York, NY: Palgrave Macmillan, 2011), 15.

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